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A Function-Based Approach to Establishing Social Skills: The Effect of an Interdependent Group Contingency on Preference for Social or Non-Social Reinforcers

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by

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Abstract

Social deficits are a commonly observed phenomenon among children diagnosed with Autism Spectrum Disorder (ASD). Social skill deficits may lead to isolation from peers and a lack of contact with naturalistic settings that are crucial to children's development. Group-oriented contingency research has proved to be a fruitful avenue in terms of producing technologies that promote social interactions between peers and reduce maladaptive behavior. Specifically, interdependent group contingencies have been shown to improve social interaction quality between youths with ASD and their typically developing (TD) peers. The current study sought to analyze the effect of an interdependent contingency on children's preferences for social or non-social reinforcers. It also sought to analyze social interactions in terms of both their quality (positive, neutral, or negative) and their contextual relevance. The effect of access to computers as a reinforcer was also analyzed. Across two experiments, interdependent contingency tasks were implemented with two sets of dyads; one with two ASD peers and one with an ASD child and a TD peer. The results showed that the relevance of utterances made by participants appeared to show greater functional control over preferences than their positive, neutral, or negative qualities. The results also showed that interdependent tasks may lead to higher rates of interactions between peers, and that access to computers can harm or augment social interactions between peers depending on the arrangement of individuals and their content preferences. Implications for future research as well as key takeaways for applied practitioners are discussed.

Keywords: interdependent contingencies, group contingencies, social skills, autism spectrum disorder

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INTRODUCTION

The DSM-5 diagnosis criteria for Autism spectrum disorder (ASD) includes, among other behavioral deficits, failures in initiating or responding to social interactions (American Psychiatric Association, 2013). Researchers have gone as far as to say that the term "autism denotes a withdrawal from social interaction with other persons" (Gaylord-Ross, Haring, Breen, Pitts-Conway, 1984). Though "social interactions" are difficult to define, both of the above sources appear to refer to a narrow repertoire of social behaviors, which may prevent individuals from being exposed to a large array of social reinforcers present in their environment. Social skills training has been an area of research within the field of behavior analysis for many years, and a 13-study review of this literature shows that group-oriented social-skills training has had an overall positive effect not only on social skills learned by individuals, but has also been correlated with positive indicators of psychological well-being (Hotton & Coles, 2016). Research in this area is incomplete, but promising interventions have been identified and continue to be developed (White, Koenig, & Scahill, 2007).

One method of intervention seeks to isolate the elements of normal social interactions to better understand and intervene upon specific deficits. Social exchanges were broken into the initiation, elaboration, and termination phases by Gaylord-Ross and colleagues (1984). Their social skills training program, which utilized this paradigm, was successful in increasing social initiations and interactions between children with ASD. One of Gaylord-Ross and colleagues' (1984) key dependent measures was the duration of time that participants spent socially interacting with peers while playing with objects and games, thus placing activity-centered interactions at the center of their social skills

training method. They were able to demonstrate generalization of taught social skills across new objects and games, however their generalization measures did not extend into diverse settings or contexts. Because of this outcome, one might assume that this social skills training method would result in a high rate of object-centered social interactions during generalization, however for multiple participants they actually measured high rates of non-object-centered communication. One possible hypothesis that can be drawn from this result is that the social interactions with peers themselves attained a reinforcing quality, and the reinforcing quality of the objects became secondary in reinforcement value.

Rao, Beidal, and Murray (2008) noted that research into social skills training has been limited by the field's difficulty in agreeing upon the elements involved in social communication. Included in Rao and colleagues' (2008) definition were distinct actions such as smiling, making eye contact, and exchanging compliments, however a cohesive account of social exchanges has remained elusive. Direct training of social skills has been extensively researched, but the generalization of directly trained skills has proven to be a limitation. In a review consisting of 10 studies targeting an increase in social skills, only 2 out of 3 studies measuring generalization were directly seeking generalization effects, and the 7 other studies reviewed did not measure generalization at all (Rao et al, 2008). The increased focus on social skills training from the 1970s onwards has produced a body of research that has sought to identify the most effective methods of combatting social deficiencies such as disruptive behavior as well as teaching appropriate social interactions. One of the most fruitful avenues of research has been the study of group contingencies.

Group contingencies have their philosophical roots in the radical behaviorism and cultural design work of B.F. Skinner (1948, 1971), though their use and scope within the field of applied behavior analysis has largely been limited to classrooms. Group contingencies were originally delineated and described as "Group-Oriented" contingencies by Litow & Pumroy (1975). They were categorized as Dependent, Independent, and Interdependent Group-Oriented Contingency Systems. Research on group contingencies has largely focused on their use for the control of disruptive behaviors and targets for decrease rather than acquisition targets (Groves & Austin, 2017). Despite this focus, Skinner, Cashwell, and Dunn noted that group contingencies "increase incidental levels of social interaction and cooperative behaviors among students," which indicates that group contingency effects extend beyond the control of problematic behaviors (p. 76, 1996).

The original definitions of the different forms of group contingencies are still in use today and the distinctions between them are subtle but important. Dependent group contingencies are described as systems in which reinforcement delivery to an entire group is dependent upon the performance of only select members of the group. Independent contingencies are those in which response contingencies are in place for all members of the group, but the reinforcement criterion are individualized. Interdependent contingency systems are those in which the same response contingencies are in place for all group members, and the collective product of the individual members' performance must meet a set criterion in order for the group to receive reinforcement (Litow & Pumroy, 1975).

Gresham and Gresham (1982) evaluated the effectiveness of all three of the above-described group-oriented contingencies in a classroom setting with 12 children

with diagnosed learning deficits. Their participants were split into two different teams and exposed to the contingencies in an ABCDABCD reversal design (see Table 1). Their primary measure was disruptive behavior engaged in during class time, and the control of this class of behaviors is one of the most widely studied uses of group contingencies in the school setting. This method of intervention has been dubbed the "Good Behavior Game" by researchers of the topic (Barrish, Saunders, & Wolf, 1969; Groves & Austin, 2017). In the Gresham and Gresham study (1982), all of the group-oriented contingencies were consistently more effective in reducing the frequency of disruptive behaviors than the baseline condition (see Table 1). Between the group-oriented contingencies, the independent contingency was least effective, the dependent contingency was somewhat effective, and the interdependent contingency was most effective. The authors asserted that interdependent and dependent group contingencies were likely more effective than the others because cooperation is present within these two contingencies, as opposed to the competitive nature of independent group contingencies and lack of cooperation in individualized contingencies. Interestingly, Gresham & Gresham (1982) also noted that within the interdependent and dependent contingencies the children participating in the study spontaneously praised their team members for low rates of disruptive behavior while reprimanding them for the emission of such behavior. Social interactions were not explicitly measured in Gresham & Greshams' (1982) study, but fortunately other research into group-oriented contingencies has put these measures in place.

Williams, Martin, McDonald, Hardy, and Lambert (1975) tested the effects of a "Backscratch" group-contingency variation on social interactions between two dyads of intellectually disabled participants living in an assisted living facility. Under this

contingency, dyads of participants are provided with reinforcement following the responding of their partner as opposed to their own responses, thus the contingency translates the phrase “you scratch my back, and I’ll scratch yours” into an experimental setting. Social interactions between participants were measured including pointing, vocalizations, touching, hitting, yelling, and eye contact. Following a baseline phase, the subjects were reinforced on an individual contingency and then subsequently placed on a backscratch contingency of reinforcement. One other key factor in this study was the focus on generalization of social interactions to settings and contexts outside of the work task. The generalization setting measured was a separate task in which participants set places at tables in their facility’s cafeteria. Generalization to the rest of the ward was also measured by experimenters. The design of the experiment was ABABA, with A representing the individual contingency and B representing the backscratch contingency. The results showed that the frequency of social interactions both during the work task and within the generalization setting increased drastically during the backscratch contingency when compared to the baseline and individual reinforcement contingencies for one pair, with similar but less pronounced effects measured for the other pair. Following the removal of the backscratch contingency in the beginning of the third A phase, social interactions dropped significantly, returning to near-baseline levels. The backscratch contingency has not been replicated in other experiments, but most closely aligns with the definition of interdependent contingencies developed by Litow and Pumroy (1975) due to reinforcement being dependent on the dyad’s collective performance. This experiment provides tentative evidence that the social interactions between peers can be increased through the mere implementation of a group contingency as opposed to direct training of

social skills, which may indicate that interdependent contingencies result in previously nonpreferred social interactions developing a reinforcing function. Whereas the social interaction measures used in the Williams and colleagues (1975) study reflect rudimentary forms of social behavior, other researchers in the field of behavior analysis have sought higher-level accounts of social interactions within the context of group contingencies.

Speltz, Shimamura, & McReynolds (1982) sought to compare three different group-oriented contingencies to determine their effectiveness in increasing academic work engaged in by children in an intellectual disability classroom. This study assessed three different group-oriented responding criteria and compared them to an individualized contingency. The group-oriented variables were setting the group-reward criteria based on the group average, the work of a designated low-performing individual, and a randomly selected student in the classroom. Their measures were social interactions coded as Positive (e.g. offers for assistance or verbal statements of encouragement), Negative (e.g. name-calling or physical aggressions), or Neutral (e.g. non-directed statements such as "this is hard" or directed general comments such as "I'm done"). Their social interaction coding was also utilized for the present study and is more explicitly described in the methods section below. Children in Speltz and colleagues' experiment were reinforced with "points" during 10-minute work periods, and these points could be exchanged for a variety of individualized reinforcers. Student performances on worksheets were also measured during the study. Their results showed that performance on worksheets was significantly better for students during the contingency conditions compared to baseline, but performance did not differ significantly between the

contingencies. Their results also showed average levels of positive interactions were significantly higher in the unidentified responder contingency and the contingencies as a whole, though not higher in the individualized or all-group contingencies specifically compared to baseline. Of particular relevance to the present study is data Speltz and colleagues collected on student preferences for the contingencies. Students rated the identified responder contingency the highest, and the individualized contingency lowest. The unidentified and all-group contingencies received intermediate ratings. This indicates that students preferred the group contingencies more than the individualized contingencies. This trend was not seen in the students who had been identified as the targets during the identified-dependent student contingency, and these target students rated the individualized contingency highest and the all-group contingency lowest. This indicates that dependent group contingencies may have some sort of aversive nature for the students whose scores are used to determine reinforcer delivery for the entire group. While Speltz and colleagues measured social interaction and task completion, their focus nor the focus of the other studies which have been described above directly targeted whether group contingencies have a measurable effect on children's preferences for social versus non-social reinforcers. There are numerous views on why children diagnosed with autism tend to show less success in social interactions with peers, one view being that children diagnosed with autism attempt to engage in conversation which is irrelevant or inappropriate to the context (Tager-Flusberg & Anderson, 1991).

In response to the question of whether the contextual relevance of children's verbal interactions can influence their relationships with peers, Tartaro and Cassell (2008) developed an intervention using a virtual peer to train children diagnosed with

ASD to engage in context-contingent discourse. In this study, high-functioning children with ASD were matched with typically developing peers whom they were familiar with from school, as well as with a virtual peer named "Sam." In dyads with either of these two types of peers, participants were shown a play castle and toys, and prompted to tell stories with the peers. Tartaro and Cassell (2008) found that children with ASD were more likely to exhibit utterances that were non-contingent than their typically developing peer, however over time their context and topic-contingent responses increased as they engaged with the virtual peer. This same effect was not seen with the typically developing peer, and child topic-management interactions with the typically developing peer did not increase over time. The authors defined appropriate topic-management as "introducing and maintaining topics in a way that is comprehensible in the context of prior discourse," and stated that by analyzing the utterances of the children in this way they could discern the function of each utterance in maintaining the verbal discourse between peers (p. 385, Tartaro & Cassell, 2008). In the current study, the measures of topic management used by Tartaro & Cassell (2008) were modified to create more behavior-analytically sensible definitions which were then used to analyze interactions between peers. This form of analysis was developed to assess whether contextually relevant or irrelevant topic introduction or maintenance appeared to have an effect on the preference for social interactions exhibited by participants.

The Current Study

The current study measured the effect of an interdependent group contingency on preference for social or non-social reinforcement as well as the frequency and quality of interactions between dyads comprised of either two children with ASD or a child with

ASD and a typically developing peer. The main dependent variable was the allocation between social or non-social reinforcers and activities chosen by the participants. This was measured in order to identify how interdependent contingencies interact with other features of social contexts and influence children's reinforcer preferences (social or non-social). Other features of social contexts examined included whether the presence of computers influenced social play preference as well as whether learning of a cooperative game could affect these preferences. Social interaction measures resulted in the opportunity for an interactional analysis between the quality and rate of social interactions and the resulting reinforcer preferences for dyads of children with diagnoses of autism spectrum disorder. These social interactions were coded using multiple methods to identify which features of the social interactions appeared to better capture the functions underlying reinforcer preferences. The two features of social interactions analyzed were 1) the positive, neutral, or negative quality of the interactions, and 2) whether utterances were contextually relevant or irrelevant. It is important to note that the goal of this study is not necessarily to increase the participants' preference for social interactions with their particular peer such that this preference maintains over time, but rather to determine whether interdependent contingencies may be useful in increasing initial interactions between peers who may not otherwise engage in social behavior. The importance of this distinction is more clearly described in the discussion section below. The above-noted variables were examined across two experiments with different dyads of children.

Experiment 1

METHOD

Participants, Setting, and Materials

The dyad (Dyad 1) in experiment 1 was comprised of an 11-year-old female, Rita, and a 9-year-old male, Ben. Both had a diagnosis of ASD, exhibited social difficulties according to interviews with parents, and were able to comprehend and follow the verbal rules used in this experiment as demonstrated by developing a proficiency in the work task after verbal explanations and "practice" trials. The participants had no prior interactions with one another before participating in this experiment. Participants were both high functioning in terms of their ability to understand and respond to verbal communication as indicated by their participation in a verbal consent process with experimenters upon recruitment.

The setting of this study shifts depending on whether the current condition is a work trial or a subsequent reinforcement period. During work trials, the participants began next to one another at a table which had the materials required for them to complete the work task in the interdependent contingency condition. This task took place in a room with a separate long table in the center of it which had chairs stationed around it. During reinforcement periods, participants were both given access to a room which was divided into two halves by a strip of high visibility tape. In the center of the room was a bin with an array of reinforcers which can be used for both individual play and cooperative play. This array included items identified as reinforcers through parent interview procedures similar to the Reinforcer Assessment for Individuals with Severe Disabilities (Fisher et. al., 1996), but with slight modifications to the interview questions

due to the higher functioning level of the participants. Parents or caregivers were asked to identify a series of types of reinforcers, which included social games and toys that serve as reinforcers for the participants. These reinforcers included movement-oriented games (e.g. mini-basketball), tangible items which could be used socially or non-socially (e.g. crayons and paper), and items that are typically non-social reinforcers (e.g. a slinky). Computers with access to Youtube® were used during particular conditions of the experiment and removed during other conditions. All other reinforcers were present during the entire duration of the experiment.

The materials used for this experiment included timers, data sheets, any reinforcers which were necessary for the reinforcement period, and any work stimuli necessary for engaging in the work trials such as plates, forks, cups, and napkins during the place-setting task described below.

Response Measurement and Inter-observer agreement

Social Reinforcement Preference

The primary dependent variable in this experiment was the percentage of 10-second intervals that the participants spent on either the social reinforcer side of the room or the non-social reinforcer side of the room. Measurement criteria were similar to those used by Call, Shillingsburg, Bowen, Reavis, and Findley (2013) in their direct assessment of social interaction preferences due to the high level of IOA and internal validity their results showed. At least 3 seconds with both of the participant's feet on either side of the line separating the two sides of the room was counted as an interval for that time, thus if participants switched sides during a ten second interval such that at least 3 seconds were spent on both sides of the line, the side on which the participant spent the majority of the

10-second interval was counted for that interval. 3-minute reinforcement sessions were split into 10-second intervals. Videos of the sessions were taken and inter-observer agreement data was calculated by having separate observers code the videos or live performance. The number of 10-second intervals in which the original observer and the video-observer recorded identical responses during intervals was then divided by the total number of intervals before multiplying this number by 100 to achieve an agreement percentage. The primary observer's data was used in graphing the social reinforcer choice intervals, as this researcher was present in the room with the participants.

The secondary dependent variables measured were frequency data on the social interactions between participants in each dyad during work trials and subsequent reinforcement periods. Frequency in this experiment was measured through determining the count of interactions of a particular code (described below) divided by the duration in minutes of the recorded work (1 minute) or reinforcement (3 minute) session.

Social Interaction Quality

The first of the interaction variables measured quality of social interactions, and the social interaction codes used by Speltz and colleagues (1982) were used for the current study due to their thorough descriptions and sufficiently high IOA percentages, as well as their definitions' use in other studies of a similar type to the current endeavor (Browning, 2017). The codes used are listed in figure 1. The categories of interactions were broken into neutral, positive, and negative interactions, with specific operational definitions of the observable behaviors listed for each category. New social interactions were counted if they occurred after 3 seconds from the previous interaction **or** if they were exhibited within 3 seconds of a peer's interaction, which is a deviation from Speltz

et al (1982) measures used. As an example, if one participant said “what is your name?” and the other participant replied “Ben,” this would count as one neutral interaction for both participants. The rate per minute of interactions was tracked separately for each participant so that separate graphs could be developed showing each participant’s changes in interaction rate over subsequent sessions. An additional deviation from Speltz et al (1982) was that interactions were noted if the students exhibited a vocal response directly after a response was exhibited by a peer, such as saying “oh!” after a peer shot a basketball, or a question asked by one participant was answered by another even if not facing each other. This data was collected by trained observers during work trials and reinforcement periods and was collected from video recordings of both types of sessions. Interaction data was scored exclusively through video for reasons discussed in the interobserver agreement portion of the results section.

Social Interaction Relevance

The second analysis developed to examine the social interactions between peers was derived from the contingent-utterance codes used by Tartaro and Cassell (2008). Tartaro and Cassell’s measures were based on a theory of mind approach to social interaction, as teaching theory of mind has been proposed as a method of augmenting conversational skills in children with ASD (Hadwin, Baron-Cohen, Howlin, & Hill, 1997). For the current study, Tartaro and Cassell’s operational definitions for conversational coding were modified to be more behavior-analytically sensible. The codes are listed in figure 2, and include relevant topic introductions, irrelevant topic introductions, relevant topic maintenance, and other utterances. The relevant topic introduction and maintenance codes as well as irrelevant topic introduction codes were

used in the data analysis presented in the results section below, while other utterances were coded but not included in this analysis. Other utterances were excluded from this analysis because what is of interest in the current study is whether participants exhibited an increased ability to maintain and introduce topics which were relevant to the context in which social interaction occurred, and brief utterances which do not sustain conversations with peers have already been shown to harm social interactions with peers (Doggett, Krasno, Koegel, & Koegel, 2013). Additionally, utterances which participants exhibited towards experimenters are unlikely to be functionally important for peer interactions, and thus may simply lead to "noise" in the displayed data.

Procedure

Initially, participants were exposed to a baseline condition (A) in which the participants' preference between social and non-social reinforcers was evaluated in a free-operant reinforcement setting, and then experimental conditions (B) began in which work trials were conducted prior to reinforcement periods under an interdependent group-oriented contingency. Finally, a cooperative game condition (C) was introduced in which the participants were taught to play a cooperative game (checkers) to proficiency prior to continuing the work and reinforcement sessions to assess whether the teaching of this game would enhance preferences for social interaction. The conditions were introduced in an ABA'B'C format, in which the initial baseline and intervention conditions (AB) included access to computers as well as other toys during reinforcement sessions, and modified (A'B') conditions included the removal of access to computers during reinforcement sessions. The reason for this modification is discussed below.

Baseline

The baseline condition of the experiment involved exposing the dyad to a series of consecutive reinforcement sessions (described below). These baseline measures were used to assess the participants' preferences for social versus non-social reinforcers prior to being exposed to the group-oriented contingency. During reversals to the modified baseline condition the participants no longer engaged in work trials prior to reinforcement periods and instead were placed in consecutive reinforcement sessions. These reversals were necessary due to the presence of computers during the reinforcement conditions serving as a confounding variable in that they completely suppressed social play behavior. This effect is discussed in the results section and served as the impetus for a computer-access condition in experiment 2.

Work Trials

Work trials in the interdependent contingency conditions consisted of 1-minute sessions during which participants were given the task of setting a table using a plate, napkin, cup, and fork. In the interdependent contingency, the dyad stood next to each other in front of a table and each participant had access to either the plate and napkin **or** the cup and fork. In the center of the table upon which participants completed the work task was a model of a correctly set place. There was also a drawn 2D model of a set place on a board visible to participants, and written instructions of the order in which the places should be set was also on this board. Prior to beginning the work session, the participants were given a verbal instruction similar to the following:

"Work together to combine your supplies into as many places set at the table as possible within a minute. You cannot exchange materials, and must work together to correctly set the table. The order of placement should be plates, then cup, then napkin,

and finally forks on top of the napkin. You may look at the provided picture to see what each place should look like. At the end of a minute, we will count how many places were set and determine whether you have set enough places to have free play time. You may begin now."

The experimenter did not interact with the dyad during the work trials. At the conclusion of the 1-minute trial, the participants were told to stop setting the places and their total number of correctly set places was counted by experimenters. The experimenter announced that the target number of places that the participants were required to set to receive access to a reinforcement session had been met. This target number was chosen by the experimenter following the counting of the actual number sorted (e.g. "you set 5 places and you had to set 3, good work"). Thus, the target number appeared to change each work trial, and yet the participants **always** met the criteria for reinforcement. This was to maintain a continuous schedule of reinforcement for work trials. This schedule of reinforcement was maintained in experiment 2 below with a second dyad. The experimenter announced the target number after counting the dyad's set places, then stated that the participants had met the criteria for access to the "reward room". Following this work trial, the reinforcement sessions began.

Reinforcement Sessions

In the beginning of each reinforcement session, the participants were directed towards each side of the room and verbally told which side of the room could be used to play together, and which side of the room could be used for playing alone. Participants were told that they were able to take reinforcers from a designated bin which contained the reinforcer array to either other side of the room so that they could either play alone or together with a reinforcer. The experimenter directed the participants to the reinforcer bin

and verbally prompted them to attend to the reinforcer array (which contain multiples of most items to ensure that the sharing of an item is not a forced choice). Following this orientation, the experimenter told participants that they could begin their 3 minute reinforcement session and the experimenter became unavailable for interaction unless an emergency occurred. Aside from an emergency such as an injury or potential for injury, the experimenter only intervened during reinforcement sessions if the participants began to socially interact or engage in play behaviors together while on the non-social interaction side of the room, or alternatively if both of the participants began engaging in non-social play behaviors (such as each child playing with a single reinforcer alone) while on the social interaction side of the room. In both of these cases, the experimenter verbally stated the rules about each side of the room to the participants as a prompt. If the participants engaged in verbal behavior towards the experimenter, the experimenter delivered a neutral response (e.g. “we can talk later”). The duration timer was not stopped during these interactions with the experimenter, and no social interactions between the experimenter and participants were coded in the social interaction quality rate data, but were coded in the social interaction relevance data as “other utterances”.

If only one participant was on the social-play side of the room and the other was not, data was tracked accordingly. Participants were able to invite the other to play with them on the social-interaction side of the room if they had the repertoire to do so, or alternatively they were able to tell to the other participant that they want to play alone if they had the repertoire. Any responses serving either of these functions were not blocked or directly trained by experimenters.

The condition change criteria were set to clearly indicate whether a steady state of responding was identified for each participant within the dyad. A steady state is defined as a participant's percentage of intervals on either side of the room producing at least 2 consecutive data points within the same 20% range. As both participants in a dyad are exposed to the experimental or baseline condition together, the additional criterion is that **both** dyad members' data will have to meet this steady state criteria (although their individualized 20% ranges need not overlap) during the same 2 consecutive sessions. Once this steady state condition was met, conditions were terminated and the next condition began. The experiment was terminated for the dyad following a steady state of responding being met in the final experimental condition.

RESULTS AND DISCUSSION

Interobserver Agreement

Interobserver agreement (IOA) for this experiment was calculated in different ways for the participants' preference for social play and their social interactions. IOA for their social play choices were calculated by taking the number of interval agreements between the experimenter in the room with the participants and the observers outside of the room. The number of agreements were divided by the total number of 10-second intervals in each reinforcement session (18 per 3 minute interval) and then multiplied by 100 to deliver a percentage. For Dyad 1 (comprised of Rita and Ben), IOA was calculated for 89% of total sessions, with a mean average of 97% agreement. Rita's agreement was calculated for 87% of sessions, and 97% interval agreement was achieved (range 83-100%). Ben's interval agreement was calculated for 91% of sessions, and agreement of

96% was achieved (range 50-100%, with the 50% session being the one outlier below 89%).

Interobserver agreement for the Social Interaction Quality between participants was calculated by having observers view videos of the work and reinforcement sessions and calculating the total agreed upon interactions per session divided by the highest number of interactions tracked between observers, which was then multiplied by 100 to get a percentage. For example, if one observer tracked 4 positive interactions and 1 neutral interaction, and the other observer tracked 3 positive interactions and 1 neutral interaction, the 4 agreements would be divided by 5 total recorded interactions for that session between observers. Using this method, IOA on social interaction quality was tracked for 32% of total sessions, with the mean average agreement reaching 98%. The range of interaction IOA was 75-100%, with only one session dipping below 80% (the 75% session). For this outlier, two observers reviewed and discussed the video multiple times before agreeing upon the interaction tracked and graphed below.

Interobserver agreement for Social Interaction Relevance between participants was calculated in the same manner as Social Interaction Quality. IOA on Social Interaction Relevance was calculate for 32.5% of sessions, with a mean average of 96% agreement (range 0-100%). There was 0% agreement for a single session in which only one interaction occurred, and observers reviewed this video together and discussed until they agreed upon the occurrence of the interaction. Thus, final IOA was 100% agreement.

Preference for Social Play

The results showed that this dyad did not initially engage in any intervals of parallel play during the baseline free operant condition (figure 3). In the reinforcement

sessions following work sessions during the intervention, Rita spent a little over 10% of the fourth reinforcement session on the social reinforcer side of the room before returning to the independent play side. During the modified baseline condition in which the computers were removed from the reinforcement session room, the percentage of intervals in which both participants interacted on the social reinforcer side of the reinforcement room immediately leapt to 100% and maintained at above 85% for both participants until the second reinforcement session after the modified intervention was introduced. At this point, Rita's social play percentage fell to 0% before rising back to 100% on the 17th reinforcement session. Rita's social play percentage then fell to 0% and maintained below 10% for the remainder of the experiment. Following the modified intervention introduction, Ben's social play choice percentage dipped to below 25% for the 15th session before rising back to 100% for the following two sessions. At this point, Rita was no longer choosing to play with Ben, and Ben's social play choices reduced to 50% and then below 15% for the remainder of the experiment. It is important to note that prior to the modified baseline and intervention conditions, both participants spent nearly all of their reinforcement session intervals watching videos on Youtube® on the individual play side of the session room.

Following the removal of all computers in the room during the modified baseline and intervention conditions, the participants began playing basketball together on the social reinforcer side of the reinforcement room with a toy ball and hoop for sessions 11 through 14. This social play behavior changed to playing with cards and a checker set on the social play side of the room during sessions 16 and 17, but the participants did not

follow the rules of checkers and these social interactions soon diminished to the levels seen throughout the rest of the experiment.

Another intervention was added after social play choices had sunk to below 20% for both participants, and this intervention consisted of checkers (a cooperative game) being taught to participants prior to continuing work and reinforcement sessions. This intervention did not appear to have any impact on the social play choices the participants made during reinforcement sessions. The cooperative game intervention was introduced for the explicit purpose of determining whether a cause of the participants' reluctance to engage in social play was due to the absence of a socially cooperative game which they could play together. The participants had been observed talking about checkers during reinforcement sessions 16 and 17 when Ben asked Rita if she knew how to play the game. It was unclear whether Rita knew the rules to the game or not, and because in this interaction the participants had indicated an interest in the game the experimenter determined that the game should be taught to both participants. By this point, preference for social play had diminished to near zero levels for both participants. The experimenter modeled gameplay for the participants and then asked the participants to play the game between themselves under experimenter supervision. The experimenter provided feedback until the participants displayed proficiency in turn-taking during the game. This training session lasted less than 10 minutes. Following this training period the participants returned to the same pattern of work and play sessions present in the intervention condition. Both participants' preferences for social play remained at zero percentage of intervals following this training, from which a tentative conclusion can be drawn that once social interaction has become non-preferred and potentially aversive, it

will not resurface merely through the training of a cooperative game. It is especially interesting to note that the game itself was not an aversive activity, as evidenced by the fact that Rita actually brought the checkerboard to the solo-play side of the room and played checkers by herself.

The pattern of participant choices shown in figure 3 shows a trend which can be described in terms of social interactions and relationships common in the natural environment. The participants initially did not interact with one another when the highly preferred reinforcer of Youtube® was available, however a drastic increase in preference for social play occurred following the removal of this reinforcer. Taken alone, this data would appear to suggest that technology can have a suppressive role in social interactions, however this is a point which will be discussed later. Further analysis of this data beyond the initial spike in social play preference shows that this preference is not static once it is established. Rita initially showed a high preference for social play with Ben (sessions 11-14), but this preference became more variable in sessions 15-17 before sharply dropping to near zero levels for the rest of the experiment. Ben's preference for social play with Rita was slower to extinguish, as shown in figure 3 in sessions 17 through 21. Even after Rita began spending the entire reinforcement session on the alone play side of the room, Ben continued to linger on the social play side of the room for 3 additional reinforcement sessions (18-20) before finally reaching zero levels of social preference. The analog to this series of events which may be found in the natural environment is a situation in which one person ceases to have an interest in spending time with a new acquaintance even though this acquaintance continues to make attempts at spending time together. The result is that Ben's preference for social play was

extinguished following Rita's diminished reinforcement of Ben's nonverbal "bids" (or mands) for social play.

Social Interaction Quality

Rita's interactions remained at 0 per minute during the initial baseline and intervention conditions, but became variable during the modified baseline condition, with positive interactions maintaining above 3 per minute until the modified intervention condition (figure 4). During the modified intervention condition, interactions returned to 0 per minute during the work session but positive interactions rose to about 4 per minute during the subsequent reinforcement session. Rita's positive interaction data then sank to below 1 per minute for the remainder of the experiment but Rita's neutral interaction data variably rose up to 7 per minute before dropping to below 2 per minute as Rita's social play choices also fell. In all sessions, Rita's positive and neutral interaction rate was equal to or higher than the negative interaction rate, which remained at 0 per minute throughout sessions.

Ben's interactions (figure 5) remained at 0 per minute throughout the baseline condition, and then saw a few mild bumps to 1 per minute during a work session in the intervention condition. This interaction was a neutral vocal "oh" exhibited when Ben dropped work supplies. During the return to a modified baseline condition, Ben's interactions showed variable rates of neutral and positive interactions peaking at about 1 per minute. Interactions did not maintain this peak during the modified intervention session, but rather sank to approximately 0.3 positive interactions per minute until reinforcement session 16. At this point, neutral interactions rose up to 6 per minute for both work and reinforcement sessions (aside from work session 17) until reinforcement

session 18 when they sank back to less than 1 per minute. They remained variable during the rest of the modified intervention condition as well as following the cooperative game intervention, and rose at most to approximately 2 per minute.

This interaction quality data allows for tentative connections to be drawn between the frequency of neutral interactions between peers and these neutral interactions' effect on the preference for social play. Rita showed a higher rate of positive social interactions throughout reinforcement sessions 11 through 14, which were primarily in the form of sharing a basketball toy with Ben while they played together on the social side of the reinforcement room. Ben rarely reciprocated these positive social interactions, and when he did exhibit positive social interactions they were never above a rate of 1 per minute. The trend which presents itself when taking figures 3 through 5 into account is that both participants' rates of positive interactions sank to near zero while their rates of neutral social interactions rose over the period of sessions 16 through 18, albeit in a variable manner. Both participants had their highest respective rates of neutral interactions during reinforcement session 17 (Ben) and work session 18 (Rita), which were immediately back-to-back. Following these spikes in neutral interactions, Rita's preference for social reinforcement immediately sank to zero levels during reinforcement session 18 and this preference did not re-emerge.

Social Interaction Relevance

Rita's Social Interaction Relevance (figure 6) remained at 0 throughout the baseline and intervention conditions. When the computers were removed during the modified baseline condition, relevant topic introductions rose to approximately .4 per minute before sinking again until Reinforcement session 16. At this point, the rate of

relevant topic introductions and maintenance of Ben's relevant topics fluctuated between 1 and 1.5 per minute with the exception of a few rates of topic maintenance reaching 2 per minute. The highest rates of relevant utterances were seen during reinforcement sessions and minimal rates of relevant interactions were seen during work sessions until work session 18. During work session 18, all interactions were relevant maintenance and Rita did not introduce any new topics. In reinforcement session 18, which directly followed this spike in relevant topic maintenance, Rita's social reinforcer choices decreased to 0% (see figure 3). There was one more bump in relevant topic introductions across reinforcement session 18 through reinforcement session 19, but nearly all interactions which followed this bump were either minimal (a single .5 per minute bump at reinforcement session 23) or relevant topic maintenance.

One interpretation of this data is that the high rate of relevant topic maintenance interactions with a lower rate of relevant topic introduction interactions shows decreasing motivation to continue to converse with Ben. In typical conversation, people may bring up new topics or topics which relate to features of the past or present context when they enjoy conversing with someone else, but this data appears to show a trend in which Rita lost interest in bringing up new topics to continue conversation and merely responded to topics introduced by Ben. This trend of a reduction in relevant topic introductions occurred alongside a shift in Rita's preference towards playing alone instead of in pairs.

Ben's Social Interaction Relevance (figure 7) appeared more diverse in its topography than Rita's beginning with reinforcement session 16, in which Ben's first irrelevant topic introduction occurred. Prior to reinforcement session 15, Ben had not issued any utterances either maintaining or introducing topics, but beginning in

reinforcement session 16 Ben issued almost .5 irrelevant topic introductions per minute and a full 2 relevant topic introductions per minute. This was correlated with a rise in the parallel play selected by both participants in the Dyad. However, there was an increasing trend in Ben's irrelevant topic introductions between reinforcement session 16 and work session 18 which was then followed by a sharp drop in parallel play choices.

This data appears to show that the sharp rise to almost 2 irrelevant topic introductions per minute which occurred during work session 18 immediately resulted in Rita's preference for social interaction dropping to zero during the reinforcement session directly after this work session. While Ben had continued to introduce an increasing rate of relevant topics through reinforcement session 15 through reinforcement session 18, these occurred in tandem with the irrelevant topic introductions aside from during reinforcement session 16 in which nearly all utterances were relevant topic introduction or maintenance. This high rate of relevant utterances during reinforcement session 16 was correlated with an increase in Rita's parallel play choices.

Ben's irrelevant topic introductions occurred periodically through the rest of the experimental conditions during each reinforcement session, which may have maintained the near-zero level of preference for parallel play shown by Rita. The low rates of topic maintenance which Ben exhibited during the rest of the experiment also show that Rita had ceased introducing new topics that Ben could respond to, and that Ben's introduced relevant or irrelevant topics were not resulting in Rita bringing up new topics of her own. In other words, the conversations between the participants in Dyad 1 became very one-sided, and teaching the participants a cooperative game was unsuccessful in increasing the relevant conversation between participants.

Experiment 2

Following the results of experiment 1, it was noted that the presence of computers appeared to have an inhibitory effect on the parallel play choices exhibited by both ASD participants. This result clouded the salience of the effects of an interdependent contingency, and in an attempt to examine the effects of an interdependent contingency experiment 2 was designed with the potential confound of computers better controlled.

METHOD

Participants, Setting, and Materials

The participants (Dyad 2) in experiment 2 included Rita (age 11) who had previously participated in experiment 1, and Josh (age 8), a typically developing male with no previous interactions with Rita or the experimental conditions. The settings and materials for both the work and reinforcement sessions remained identical to experiment 1. Sessions for experiment 2 began approximately four months after the conclusion of experiment 1.

Response Measurement and Inter-observer agreement

The main dependent variable in experiment 2 was cooperative play choices, which is a measure similar to the social play measure in experiment 1 with one important distinction. Instead of participants being free to move between playing together and alone during each reinforcement session, they were presented with a plastic sheet with icons representing solo or cooperative play upon the start of each reinforcement session and upon each minute which passed during the 3 minute sessions, for a total of 3 choices per session. They marked their choice using a marker each minute, and the experimenter then showed these boards to observers outside of the room who recorded the participants'

responses. In this way, a ratio of cooperative play choices could be derived by dividing the number of cooperative play choices by three total choices per session. Thus, if a participant chose to play together all three times the ratio would be 1, and if they chose to play together two out of three opportunities the ratio would be .66. IOA was collected by having two observers present outside of the reinforcement session room each recording the choice made by each participant and comparing the choices they recorded.

Social interaction quality and relevance were tracked for experiment 2 in exactly the same manner as in experiment 1, and IOA was collected on these interactions in the same manner as well.

Procedure

The in-session procedures in experiment 2 were identical to the procedures used in experiment 1 with the exception of the instructions given to participants during reinforcement sessions and the method in which they chose to play together or alone. In experiment 2, participants were told upon entry into the reinforcement session room that they could choose to play together or alone, and they could mark their choice on the plastic sheets that the experimenter presented to them each minute of the reinforcement session. Aside from this instruction, the orientation to the room and the reinforcers present was identical to experiment 1, including the sides of the room serving as either solo play or parallel play areas. This distinction between sides of the room used for either style of play was maintained to reduce the potential that the side of the room factor was a confound between experiments.

After making their choice, the experimenter told participants whether they would be playing together for the next minute or alone for the next minute. In cases where both

participants chose the same play style, the experimenter told them to play in the chosen style. In cases where the participants chose different play styles, they experimenter selected one of the participants' choices as the play style for the next minute based on a randomized set of numbers which had equal chance of selecting Rita or Josh's selection. Thus, if Rita chose play together and Josh chose play alone, they had an equal chance of their choices being selected and engaged in for the following minute. This also meant that occasionally participants could find themselves engaging in a play style that they did not choose. The three-minute reinforcement session timer was not paused while choices were made.

The only other difference between experiment 1 and experiment 2 was that the conditions introduced to the participants were altered into an ABCB format. The A condition was a baseline in which Dyad 2 participants had access to the reinforcement room for consecutive sessions until a steady state of play choices was attained. The B condition was the introduction of the interdependent task in which a work trial preceded each reinforcement session The C condition involved the presence of computers in the reinforcement session room while work trials prior to these reinforcement sessions continued. A steady state of choices was determined if the proportion of choices for solo or cooperative play did not change for both participants across at least four consecutive reinforcement sessions, though in baseline this was extended to an additional session. Through arranging the conditions in this manner, the effect of the interdependent contingency could be assessed without interference from the highly preferred reinforcer of computers, however in turn the effect of computers could be assessed in a follow-up condition.

RESULTS AND DISCUSSION

Interobserver Agreement

IOA for the ratio of cooperative play choices was taken for 100% of reinforcement sessions, and 100% agreement between observers was attained. Social Interaction Quality IOA was gathered for 43% of Dyad 2's sessions, with a mean average of 82% agreement (range 58%-100%). Due to this wide range of IOA, trained observers reviewed sessions in which agreement less than 80% had been reached and discussed any discrepancies in interaction data. The data graphed is the outcome of this discussion and review, and IOA after this review reached a mean average of 95% agreement. Social Interaction Relevance IOA data was taken for 29% of Dyad 2 sessions and an average agreement of 79% (range 40%-90%). Again, videos were reviewed and discussed by two trained observers for sessions with IOA less than 80% and the data discussed below was the result of this review and retake. The IOA after this review reached 92% for Dyad 2.

Cooperative Play Choices

Rita and Josh's cooperative play choice ratios are shown in figure 8, and they were identical across sessions throughout the entire experiment. During the baseline sessions, both participants chose to play together during the initial reinforcement session, but then only selected to play together 1 out of 3 opportunities in the second reinforcement session. This quickly rose to choosing to play cooperatively each session throughout the rest of the baseline task and the introduction of the interdependent task. Both participants' ratio of cooperative play choices sank during the addition of the computers into the reinforcement session room, however after reinforcement session 10 in which zero cooperative play choices were made both participants chose to play

together one of three opportunities in reinforcement session 11. This trend continued into the rest of the reinforcement sessions during the experiment in which both participants chose to play cooperatively consistently until the experiment was terminated. This may indicate that while the interdependent task did not appear to have any effect on social reinforcer choices, the computers once again inhibited participant preferences for social reinforcers. This inhibition only lasted two reinforcement sessions, however, and soon the participants began watching videos together on the social play time of the room after selecting to play cooperatively. This may suggest that while computers are not an inherently social activity, the reinforcement value derived from computer access (and Youtube® specifically) can be shared across participants if they are able to find videos they wish to watch together.

Social Interaction Quality

Rita's Social Interaction Quality (figure 9) was initially stable between 2 and 3 neutral interactions per minute, but rose steadily throughout the baseline condition until it stabilized at between 6 and 8 per minute during the interdependent task condition. Positive interactions rose variably during work sessions in the Task and Computers condition to rates of between ~4 and 10 per minute, with positive interactions in the reinforcement sessions also steadily rising throughout this condition before peaking at around 2 per minute. The rate of neutral interactions reverted to between 1 and 3 per minute after the introduction of the computers, but then steadily rose in both work and reinforcement sessions before peaking at around 5 per minute. Neutral interactions were then variable after the removal of the computers and remained variable for the rest of the experiment, while positive interactions remained at around 1-2 per minute during work

sessions and less than 1 per minute during reinforcement sessions. Negative interactions were only seen once during reinforcement session 8 and at a rate of less than .5 per minute. The data and trends indicate that work sessions may have led to a higher rate of neutral or positive interactions, and that the effects of this rise maintained during work sessions even after computers were introduced and the preference for cooperative play sank.

Josh's Social Interaction Quality (figure 10) was initially mostly comprised of neutral interactions, however as his cooperative play choices became steady during the baseline condition his negative interactions rose to a steady level at about 1.5 per minute, while neutral interactions remained between 3.5 and 7 per minute during this time. The rate of neutral interactions rose to average around 7 per minute after the introduction of the interdependent task, while negative interactions only appeared to occur during reinforcement sessions. These interactions were in the form of "teasing" utterances such as "you're dead!" and "I wrecked you!" as the participants played a card game together. It is important to note that this rise in negative interactions was actually correlated with steady cooperative play choices by Rita, indicating that this teasing behavior exhibited by Josh did not cause Rita to avoid playing with him. Josh's neutral interactions were variable after the introduction of the computers, as were positive interactions, although these positive interactions remained at an average of around 3 per minute during nearly all work and reinforcement sessions during this condition. After the computers were removed, neutral interactions appeared to show a highly variable decreasing trend as positive and negative interactions both remained at or below 2 per minute before dropping to less than 1 per minute just before the experiment ended. This may indicate

that the presence of the computers had actually come to set the occasion for varied responding. It also shows that though computers initially stifled positive and negative responses during work and reinforcement session 10, the positive interaction rate then increased throughout almost all sessions in the condition.

Social Interaction Relevance

Rita's Social Interaction Relevance measures (figure 11) in baseline showed steady relevant topic maintenance, with a spike to almost four per minute during the final reinforcement session of the baseline condition. Her relevant topic introduction rate rose to about .5 per minute and maintained at this rate during the final three sessions of baseline as well. During the interdependent task, Rita showed higher rates of relevant topic maintenance utterances (about 4 per minute) while relevant topic introductions also showed a variable but steadily increasing rate throughout this condition as well. Following the introduction of computers during reinforcement session 10, relevant utterances dipped to around 1 per minute before relevant topic introductions again began to steadily rise towards almost 3 per minute before settling into a consistent trend of 2 per minute. Relevant topic maintenance was variable, as a high rate per minute of these utterances occurred during work sessions and a lower rate but still rising trend also occurred in reinforcement sessions. Following the removal of the computers after work session 15, relevant topic introductions lowered and remained steadily around 1 per minute and relevant topic maintenance utterances averaged around 3 per minute. During the entire experiment, irrelevant topic introductions occasionally rose to no higher than 1 per minute before sinking to near zero rates or extinguishing completely. These data may suggest that the interdependent work task resulted in a rising trend of relevant topic

introductions and maintenance, and the presence of computers initially suppressed these utterances before they quickly resurged to even higher rates. Computers may have facilitated relevant conversation between participants as they discussed the videos that they watched together and made comments about these videos. These social interactions maintained during the final condition, though at a lower rate than what was seen during the presence of the computers.

Josh's Social Interaction Relevance measures (figure 12) showed a maintaining high rate of relevant topic introductions (3 per minute) and a rising trend of relevant topic maintenance utterances as Rita began producing relevant topic introductions of her own. After the introduction of the interdependent work task, relevant topic maintenance rose to an average of 5 per minute, and relevant topic introductions sank to around 2 per minute before rising to 3 per minute. After the introduction of computers, a decreasing trend in relevant topic introductions was seen initially and the rate of these utterances remained variable throughout the rest of the condition, ranging from around 2 per minute to 5 per minute during the final work and reinforcement session of the condition. The same highly variable trend in relevant topic maintenance seen in Rita's data was also seen in Josh's, with work sessions resulting in a high rate of utterances and reinforcement session utterances remaining steadily around 2 per minute. During the final condition, relevant topic introductions continued to be variable between 2 per minute and just over 4 per minute. No clear trend was seen in relevant topic maintenance either, though relevant maintenance utterances appeared to decrease during work sessions and remain high during reinforcement sessions during this final condition.

This same trend of increased relevant utterances during the final condition occurred in Rita's data, indicating that the removal of the computers may have resulted in participants returning to conversation between themselves as a source of reinforcement during reinforcement sessions. One clear distinction between Rita and Josh's data was the rate of irrelevant utterances, with Josh displaying only two sessions during the entire experiment when these utterances occurred at a rate of no more than 1 per minute while Rita displayed irrelevant utterances during 8 different sessions. It was clear that the rate of relevant utterances of both the topic introduction and maintenance type rose for both Josh and Rita when their cooperative play choices increased, showing that they quickly settled into a routine of playing together during baseline and this routine resulted in a high rate of relevant utterances.

GENERAL DISCUSSION

The results attained across these two experiments shed light upon how children's preference for social play is affected by environmental factors such as cooperative tasks or access to computers, and they also show how verbal utterances exhibited by either peer may impact these preferences. Thus, it is worth reviewing the effects of each of these factors in turn as they applied to either Dyad 1 or Dyad 2.

A primary goal of the current study was to analyze whether interdependent contingencies had an effect on the participants' preference for social interaction, which is a necessary area of study because it is their preference for social interaction which may in part determine their exposure to social settings which shape the course of their development. Butterfield & Arthur (1995) claimed that an increase in the quality of social interactions is necessary for fostering communication skills as children develop into

adulthood, and that creating more opportunities for social interactions to occur is essential to this process. If children develop a preference for social interactions and games through group-oriented contingencies, this could exponentially increase the number of social interactions that they are likely to encounter throughout their lives. Goldstein and Brown (1989) have shown that peer modeling and observational learning leads to significantly increased rates of language acquisition, thus an increase in probability of social interaction may create more opportunities for the learning of complex social behaviors. Sameroff (2009) described this interplay between the individual and their environment as essential, stating that "the development of the child is a product of the continuous dynamic interactions of the child and the experience provided by his or her social settings." Based on the results of the current study it is difficult to conclude whether the interdependent task led to an increase in social interactions for Dyad 1, but the data shows that for Dyad 2 there was a marked increased in relevant utterances for Rita once this condition was introduced. As Rita was the only participant in Dyad 2 with a diagnosis of ASD, this indicates that an interdependent contingency, when applied with typically developing peers, may foster relevant conversation between peers.

It is important to note that social interactions are complicated at every level, and children with ASD are not the only population who struggle with maintaining social relationships with others. Typically developing people of all ages may find themselves working with a peer with whom they do not interact positively with, and the social preference data gathered for Dyad 1 did not appear to show anything drastically different from the observations one could draw from their everyday experiences. The goal of the current study was not to show that interdependent contingencies are capable of creating a

relationship between peers which leads to consistent choices to play together, but rather to determine whether interdependent contingencies are useful in establishing **initial** interactions between peers who may otherwise not interact. Following the establishment of these initial interactions, other interventions developed within applied behavior analysis which are more focused on controlling the topographies of these interactions may be able to control whether these interactions are lasting. Indeed, with Dyad 1 in particular the relevance or irrelevance of Ben's utterances appeared to play a functional role in Rita's preference for continuing to play together. Our primary interest here is whether interdependent contingencies have an effect on the probability that these initial interactions will occur, and the data gathered for Dyad 2 indicates that there is tentative reason to suspect that they have a positive effect. For Dyad 1, however, the presence of the computers appeared to be the main variable suppressing social play preferences during the first two conditions of experiment 1.

Having electronics, specifically Youtube®, available to Dyad 1 during initial reinforcement sessions may have confounded the data by serving as too powerful an establishing operation for independent play. A similar effect was seen in Experiment 2 during the first two reinforcement sessions following the introduction of the computers, during which time Rita and Josh's preference for social play diminished entirely before quickly reemerging in subsequent reinforcement sessions. The parents of both of the participants in Dyad 1 reported on a RAISD interview-style preference assessment that videos on Youtube® were one of their child's primary preferred items in the home (Fisher, Piazza, Bowman, & Amari, 1996). They noted that Ben preferred videos of LEGO® sets, while Rita preferred music videos. Thus, the video preferences between

participants in Dyad 1 did not overlap, while in Dyad 2 both participants enjoyed watching "Try Not to Laugh" videos featuring people falling and other silly scenes. This indicates that not only is access to Youtube® a factor which applied behavior analysts should take into account during social skills training involving peers, but the preferences for Youtube® content may need to be taken into account as well. If content preferences are shared between peers, as in the case of Dyad 2, social interactions appeared to be augmented (or at least unharmed) by this access. Aside from shared content preferences, the differences in social play preferences between Dyads may also be due to whether or not the peer dyad was comprised of two children with ASD or a child with ASD and a typically developing peer.

The research examining connections between Autism and Youtube® usage is limited, but one study using a non-clinical population found that on average individuals with more Autistic traits showed an increased likelihood of compulsive internet usage (Finkenauer, Pollmann, Begeer, & Kerkhof, 2012). Another study examined the usage of videogames, social media, and television by children with ASD and their typically functioning siblings, and found that children with ASD spent approximately 62% more time engaged in these activities than participating in all non-screen activities combined (Mazurek & Wenstrup, 2013). In Mazurek and Wenstrup's (2013) study, boys with ASD spent 2.4 hours per day playing video games compared to the 1.6 ®hours of use displayed by their typically developing siblings. Girls with ASD had an even larger difference between their video game usage and that of their siblings (1.8 vs. .8). It is noteworthy that Mazurek and Wenstrup's (2013) study as well as others have found that though "screen time" is on average higher for children with Autism than their typically

functioning peers, the actual topography of this usage is not usually comprised of social media use, providing further evidence that technology poses a threat to social interactions in individuals with ASD (Mazurek & Wenstrup, 2012; Mazurek, Shattuck, Wagner, & Cooper, 2012).

This is not to say that access to technology is necessarily harmful for social interactions between children with ASD and their peers. Technological interventions such as iPad ® apps have emerged as a method of indirectly training social skills in the hope that skills taught in the applications generalize into interactions with peers (Fletcher-Watson et al, 2016). However, Fletcher-Watson and colleagues (2016) did not see a marked increase in natural environment social interactions in 27 participants who were exposed to an iPad-based game intended to augment social skills. Brodhead, Courtney, and Thaxton (2018) found that due to repetitive behaviors being a common trait among children with autism spectrum disorder, technological applications such as the one noted above may require additional supports such as activity schedules to be used appropriately. Brodhead and colleagues also acknowledged that the wide-spread use of electronics among this population may serve as a barrier to social interaction interventions, and the data collected for Dyad 1 during the present study corroborate this effect. Both Rita and Ben engaged in the repetitive viewing of Youtube® videos during each reinforcement session prior to the removal of the computers, aside from a brief interval of playing with LEGOs® that Ben engaged in directly following the initial intervention phase. The suppressive effects on social play that was shown in Dyad 1 requires further evidence, and future studies should also examine the mediating variables that led to this effect with Dyad 1 and not Dyad 2.

Beyond the independent variables manipulated throughout these experiments, it is also important to examine the functional relationships between the types of verbal interactions exhibited by participants and their preferences for social play. Social Interaction Quality as measured in positive, neutral, and negative terms did not appear to have as much explanatory power over the resulting participants' preferences as the relevance of verbal utterances. For example, the experimenters noted that Ben began asking Rita a series of questions which were irrelevant to the current setting (e.g. "are emperor scorpions poisonous?") beginning around reinforcement session 16 (figure 7). Skinner in his analysis of verbal behavior (1957) noted that individuals who exhibit an excessive amount of mands are likely to "move the listener to revolt" and this may decrease responding (p. 41). One possible analysis of the data collected for Dyad 1 is that Ben exhibited a heightened amount of mands in the form of questions irrelevant to the current context, and this resulted in Rita's preference for social interaction to diminish significantly.

Ben's excessive attention to the details of a subject irrelevant to the context (i.e. scorpions) is common in individuals diagnosed with ASD, and treatment models such as Pivotal Response Training have been used to treat these specific issues (Vernon, 2017). The Relevant Interaction data collected for Dyad 1 represent a specific example of this common social deficiency within the ASD population. This result has implications for researchers studying social interactions in that the Interaction Relevance coding appeared more useful in examining the effect of these interactions than the Interaction Quality coding. In addition, cooperative play choices rose in Dyad 2 when relevant topic introductions rose, providing further evidence that the method of coding used in this

study should be further researched. The classifications of relevant social interactions developed in this study may prove useful for Applied Behavior Analysts seeking a measurable unit of verbal behavior to target for increase in socially deficient clients. The relevance of verbal utterances appeared to have more explanatory power for participant preferences than social interaction quality, however researchers have pointed out that the quality of these interactions remains important in the analysis of social relationships.

This paper makes the case that it is the reinforcing value of social interactions which may be altered by group-oriented contingencies or relevance of utterances, but other researchers have made the case that the social deficiencies seen with ASD populations are not due to a lack of interest (White et al, 2007). There are certainly factors other than a lack of interest which can impact the likelihood that children with autism will seek out social interactions with peers, including isolation and rejection (Chamberlain, Kasari, & Rotheram-Fuller, 2007). The data collected for Dyad 1 appeared to illustrate an instance of peer rejection, albeit not in the form of negative interactions, which remained at zero levels throughout the experiment. In fact, preference for social interactions appeared to increase for both participants in Dyad 2 following a rise in Josh's negative verbal interactions. The topography of these interactions were typical child-like "teasing" such as "you're so dead!" during the playing of a cooperative game. Thus, it may not be peer rejection in the form of verbal utterances which necessarily control preference for social play, but rather overt indications of choice. For example, Rita made an abrupt shift to playing on the non-social side of the reinforcement room and continued to play alone for the duration of the experiment following reinforcement session 17. Ben's preference for social interaction diminished over a few successive trials following

Rita's abrupt preference shift, and it appears that Ben's choice behavior towards social interaction was extinguished by Rita's non-social choice behavior. Data across Dyads 1 and 2 appears to show that repeated exposures to negative interactions plays a less functional role in determining social reinforcer preference than rises in irrelevant utterances and overt displays of preference for non-social play shown by dyad partners.

One key limitation of this study is that generalizing the results into a typical classroom setting is difficult. The continuous schedule of reinforcement that was used in the work task conditions across both experiments is not necessarily reflective of the varying reinforcement schedules that would likely be encountered if the participants were engaging in schoolwork. The participants were **told** that they must achieve the target number of successful places set around the table in order to receive access to the reinforcement session, however they never encountered an instance in which they did not achieve this goal. The continuous reinforcement schedule is included as an element of this study to reduce the number of variables that could impact the session-by-session behavior on the part of the participants, however this presents a potential issue because the participants' behavior was assumed to come under the control of the rules presented during the task rather than direct contact with a differential reinforcement schedule. Research has shown that generalized if-then rules can be taught to children with ASD and the rule presented to participants in this study was in the form of an if-then arrangement, thus the rule was presumably effective in controlling the behavior of the participants (Tarbox, Zuckerman, Bishop, Olive, & O'Hora, 2011). The question of whether the interdependent contingency introduced in the present study is generalizable into a

classroom situation in which the reinforcement schedule is constantly changing remains to be examined in future studies.

Another key limitation in this study is the lack of internal replications of conditions across Dyads. While nearly all of the independent variables manipulated in Experiment 1 and 2 were the same (aside from the cooperative game teaching for Dyad 1), the order in which they were introduced across Dyads was reversed. It may have been functionally important that Dyad 1 had access to computers upon their initial introduction to the reinforcement room while Dyad 2 did not. The shift in method of tracking social play preferences between Experiment 1 and 2 also makes comparison between the two Dyads' responses difficult, as the requirement to directly choose between playing alone or together in a setting which did not allow participants to easily hide their preferences may have caused Dyad 2 to choose to play together more frequently. Indeed, Rita and Josh would often verbally state what they were marking on their preference sheet so the other could hear. This could also serve as evidence that typically developing peers are helpful for the social development of ASD children in that they may be more capable of collaborating and providing guidance, which other theorists have postulated (Tartaro & Cassell, 2008). The presence of a typically developing peer may have set the occasion for collaborative decision-making in that they were more likely to openly discuss their preferences for social interactions during each choice measure. Josh's discussion of his preferences may have had an effect on Rita's choices, for example at one point Josh remarked while marking his choice sheet, "imagine if one of us chose play alone…" which may have implied an aversive social consequence for Rita if she chose to play independently. Regardless of this potential effect, the results of this experiment provide

evidence that pairing children with ASD with typically developing peers may be helpful in increasing their preference for social play.

Future research should assess the success of training social skills (and subsequently their generalization across individuals and settings) when using traditional methods of training social topographies versus utilizing group-oriented contingencies. This paper argues that the establishment of social-interactions as a reinforcer through the use of group-oriented contingencies would denote a function-based approach to the training of a social behavioral repertoire rather than a topographical approach. The increased rate of social interactions between peers in Dyad 2 may provide evidence that group-oriented contingencies increase the likelihood that individuals with ASD will seek out social interactions with a peer in a free operant setting once they have cooperated on a task. The preference for social interactions did not appear to be significantly affected by the interdependent task in either experiment, but the rate and features of verbal interactions appeared to be positively affected by these contingencies in Experiment 2. This finding and others in this study have implications for front-line behavior analysts.

Conclusion

Applied Behavior Analysis practitioners may want to utilize interdependent contingencies to augment their clients' social interactions with peers. Based on the increased levels of sustained interaction seen in Dyad 2 as opposed to Dyad 1, practitioners should intentionally pair their high-functioning clients with peers who are typically developing or who already show high rates of relevant utterances. Typically developing or high-functioning peers are able to model relevant conversation and the maintenance of this conversation, which may in turn reinforce relevant utterances made

by children with ASD. High rates of relevant utterances were correlated with a higher degree of preference for social interaction between peers, while high rates of irrelevant utterances appeared to lead to the opposite preference. Thus, there may be an appetitive quality to engaging in conversation which is coherent and relevant to participants' current contexts. This result has implications for future research on the measurement of social interactions, as coding interactions along a relevant/irrelevant scale showed greater functional utility than coding them along a positive/neutral/negative quality scale.

A final point for applied practitioners is that the use of technology, specifically computers or Youtube®, should be done carefully and with sensitivity to the different effects that technological reinforcers can have on their clients. For Dyad 1, Youtube® appeared to be so powerful as a reinforcer that it almost entirely displaced both Rita and Ben's preferences for other types of reinforcers. For Dyad 2, however, the content that was watched by Rita and Josh appeared to reinforce cooperative and active engagement by both participants as they commented on and responded to the videos. These results indicate that the use of technological reinforcers such as Youtube® videos or tablets may have positive or negative effects on child interaction depending on the composition of peers, their preferences, and their individual interactional repertoires. This study identifies a series of functional variables which may impact social interactions between children with and without Autism Spectrum Disorder, and the above-noted implications warrant further investigation in more controlled experimental arrangements.

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MEDIANS, MEANS, STANDARD DEVIATIONS, AND RANGES AS A FUNCTION OF CONDITION

Condition	Median	Mean	Standard deviation	Range
Baseline 1	34	33	3 19	27–36
Interdependent 1	12	11	3 49	6–16
Dependent 1	16	16	4 54	9–23
Independent 1	21	25	9 27	11–37
Baseline 2	24	24	2 37	22–28
Interdependent 2	8	11	5.90	5–19
Dependent 2	14	14	2.76	9–17
Independent 2	25	27	5 55	22–38

Table 1: Median, Mean, Standard Deviation, and Range of frequency of disruptive behaviors for all conditions of Gresham and Gresham (1982). Table displayed as published in original article.

Definitions for Behavior Observation Categories

Interacting with peer, neutral

The student is interacting with a peer or peers. The following *verbal* behaviors are coded in this category:

1. General discussion or nonnegative comment directed to a peer(s), (e.g., statements or questions such as "Look at this."; "What are you doing?").
2. Nondirected verbalizations intended apparently to evoke a verbal or nonverbal response from a peer(s) (e.g., "This is hard!"; "I'm done.").

Interacting with peer, positive

The following *verbal and/or nonverbal* behaviors are coded in this category:

1. Verbalizations or gestures of friendship, concern, congratulations, gratitude, or encouragement (e.g., compliments, cheering, handshaking, back patting).
2. Requests or offers for assistance or instruction, or gestures apparently for assistance.

Interacting with peer, negative

The following *verbal and/or nonverbal* behaviors are coded in this category:

1. Name calling or swearing at peer(s).
2. Laughing at a peer's mistakes.
3. Threats of physical aggression.
4. Physical aggression (e.g., hitting, slapping, biting, pushing, rough/forceful back slapping).
5. Obscene gestures, gestures of disgust or disapproval, gestures intended apparently to antagonize or frighten peer(s).
6. Behaviors which prevent or interfere with a peer(s)' work activities (e.g., taking a peer's worksheet or pencil).

An interaction is considered "directed toward a peer(s)" when: (a) another peer's name is used by the student *or* (b) the student's head is completely oriented toward a peer(s) *or* (c) the student is making physical contact with peer(s).

Figure 1: The operational definitions used by Speltz and colleagues (1982) were also used in the present study for the coding of social interactions between peers, with slight modifications noted below. Figure is shown as originally published.

Social Interaction Relevance Coding:

1. *Relevant Topic Introduction*: An utterance which contains referents to stimuli which have been contacted by both members of the dyad within the context of past or current verbal interactions *or* contains referents to stimuli in the physical environment. Must be exhibited after at least 3 seconds of previous utterance.
    a. I.e. "What game should we play?" "I like this game" "Last week we had fun playing this"
2. *Irrelevant Topic Introduction*: An utterance which **does not** contain referents to stimuli which have been contacted by both members of the dyad within the context of past or current verbal interactions *or* contains referents to stimuli in the physical environment.
    a. I.e. "I like bananas" "Have you been to California?" "I lost a tooth a year ago"
3. *Relevant Topic Maintenance*: An utterance which is exhibited within 3 seconds of a partner's topic introduction and refers to verbal or physical stimuli referred to during the topic introduction.
    a. "I'm glad you asked me to play this game." "That's a good choice!" "I like dogs too!"
4. *Other Utterances*:
    1. Do not contain referents to relevant or irrelevant stimuli which have been contacted by both members of the dyad within the context of past or current verbal interactions *or* stimuli in the physical environment.
    2. Brief utterances which are purely intraverbal or contain no words.
        a. I.e: "I don't know" "Yes" No" "Okay" "Huh…"
    3. Utterances directed towards Experimenters

Figure 2: Social interaction codes are described for the Social Interaction Relevance measure.

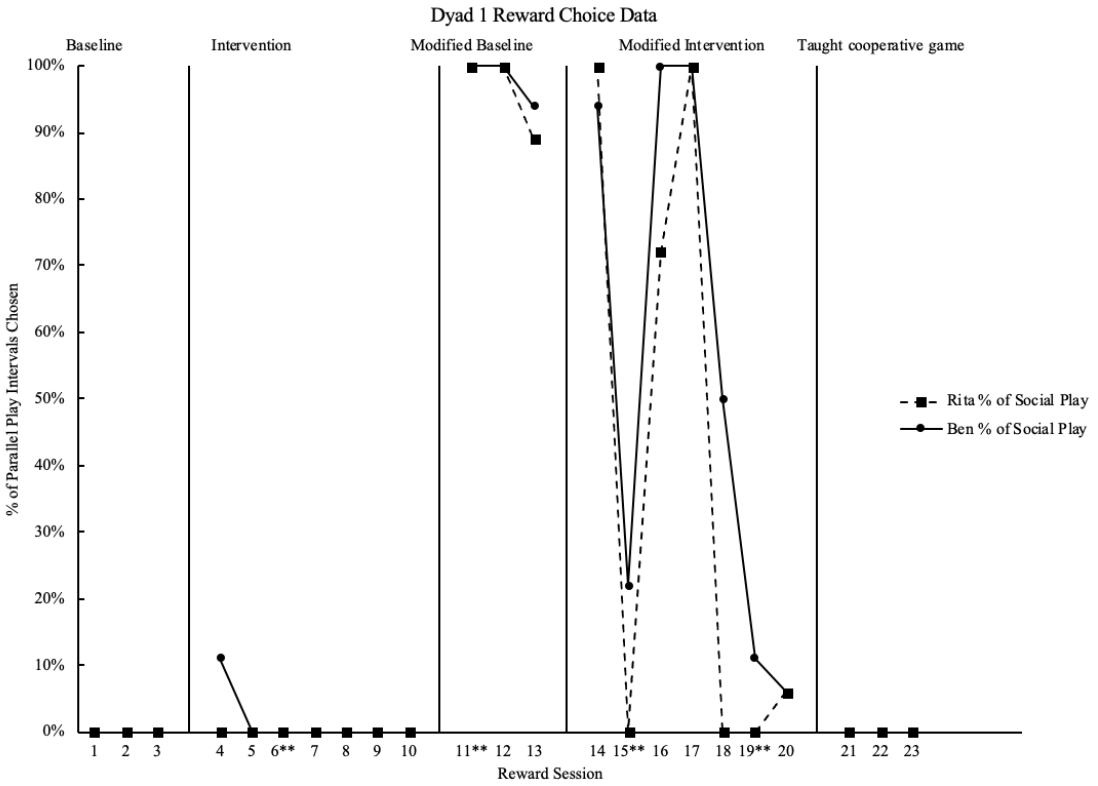

Figure 3: Shown above are the results of Dyad 1's Reinforcement sessions. The percentage of total 10-second intervals in which participants chose the social reinforcer side of the room is shown along the y axis, and reinforcement sessions are along the x axis. Sessions marked with (**) were the first sessions of a new day.

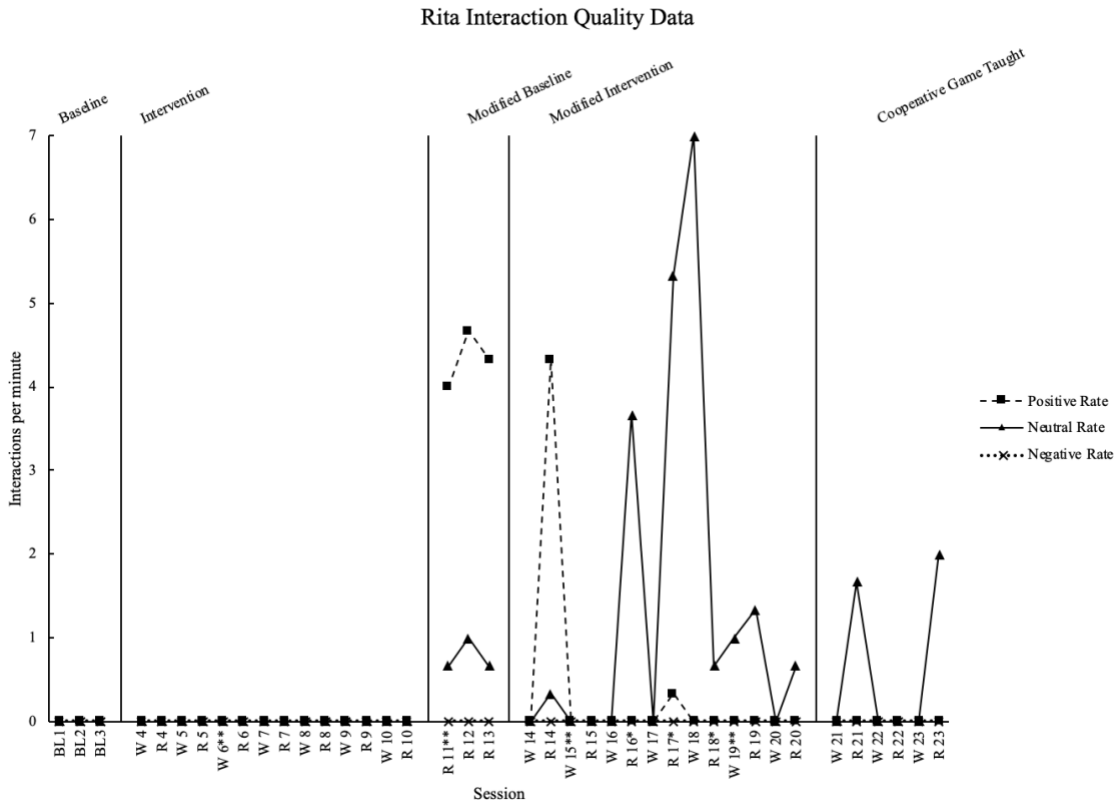

Figure 4: Shown above are Rita's Interaction quality data, with the three data paths representing positive interactions, neutral interactions, and negative interactions. Along the y-axis is the rate of interactions per minute. Along the x axis are the baseline reinforcement sessions (BL), the work sessions (W#), and the reinforcement sessions (R#). An (*) symbol next to R16-18 represents Reinforcement sessions in which an extra 10-s interval occurred due to a timer issue. Sessions marked with (**) were the first sessions of a new day.

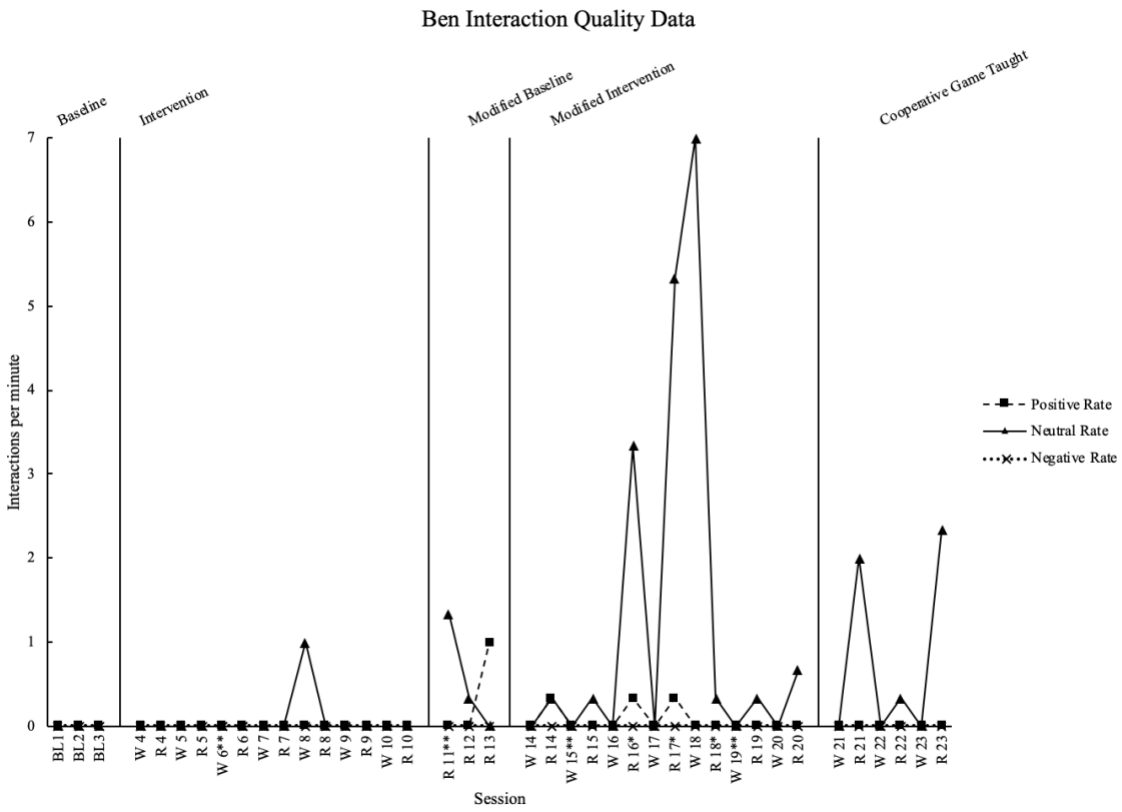

Figure 5: Shown above are Ben's Interaction quality data, with the three data paths representing positive interactions, neutral interactions, and negative interactions. Along the y-axis is the rate of interactions per minute. Along the x axis are the baseline reinforcement sessions (BL), the work sessions (W#), and the reinforcement sessions (R#). An (*) symbol next to R16-18 represents Reinforcement sessions in which an extra 10-s interval occurred due to a timer issue. Sessions marked with (**) were the first sessions of a new day.

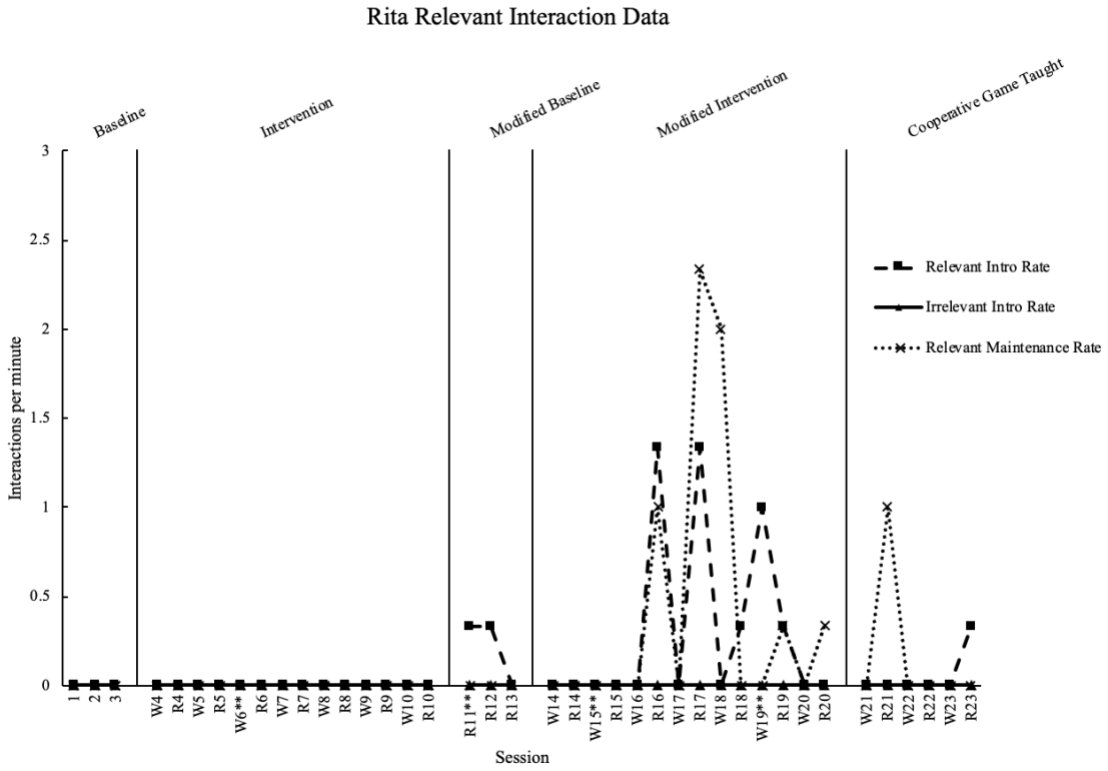

Figure 6: Social Interaction Relevance is shown for Rita. Rate of Interactions is along the y-axis, and sessions are along the x-axis and identified as work (W#) or reinforcement (R#) sessions. Sessions marked with (**) were the first sessions of a new day.

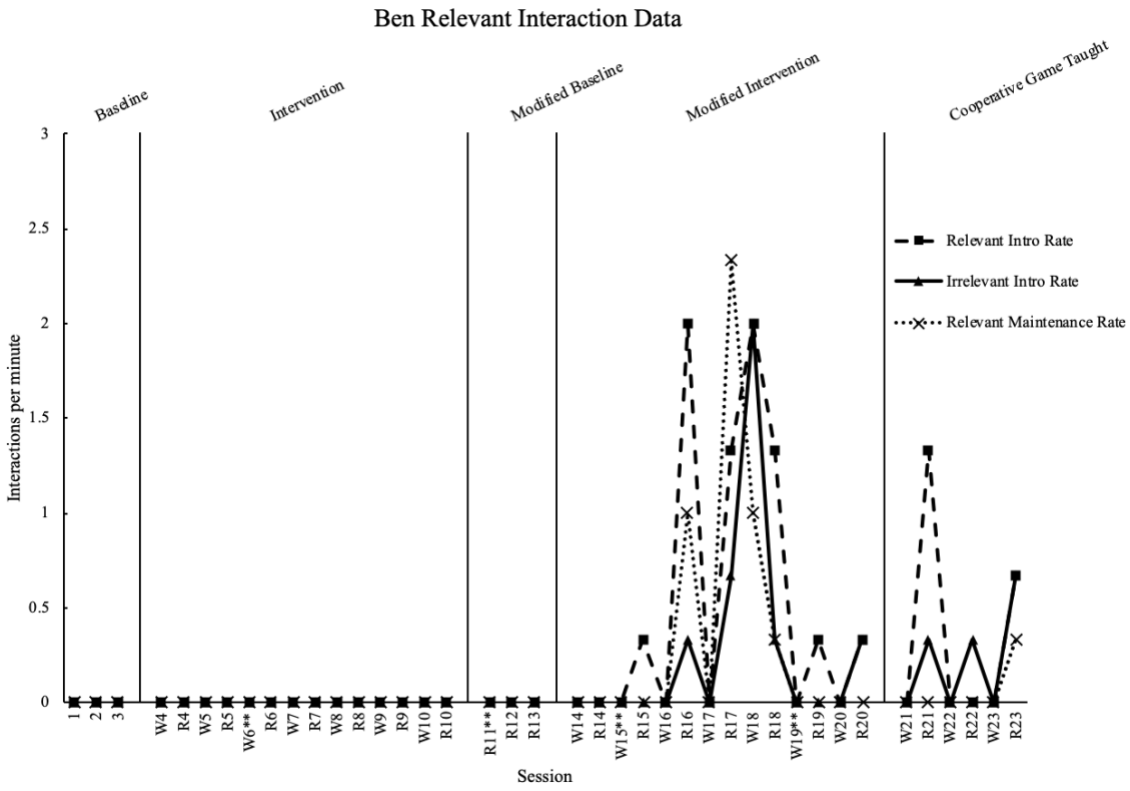

Figure 7: Social Interaction Relevance is shown for Ben. Rate of Interactions is along the y-axis, and sessions are along the x-axis and identified as work (W#) or reinforcement (R#) sessions. Sessions marked with (**) were the first sessions of a new day.

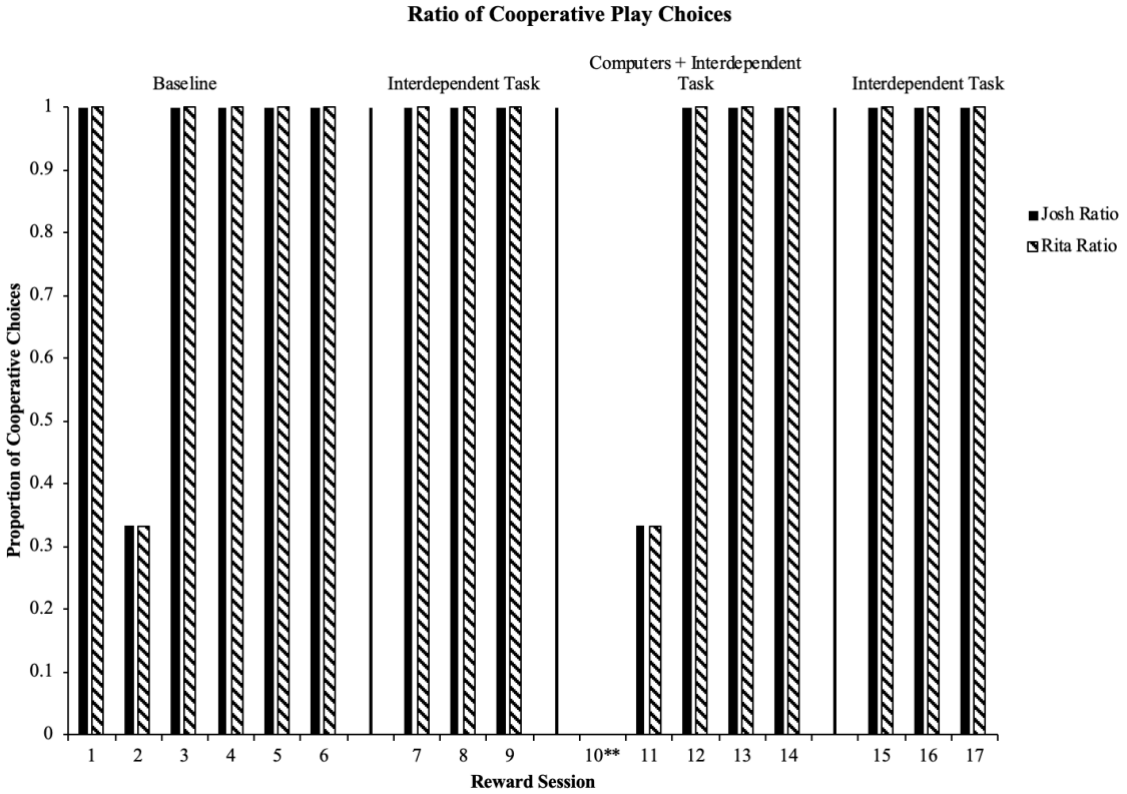

Figure 8: The ratio of cooperative play choices is shown for both Rita and Josh, with reinforcement sessions along the x-axis and the ratio along the y-axis. The ratio of choices was identical for both participants across reinforcement sessions. Sessions marked with (**) were the first sessions of a new day.

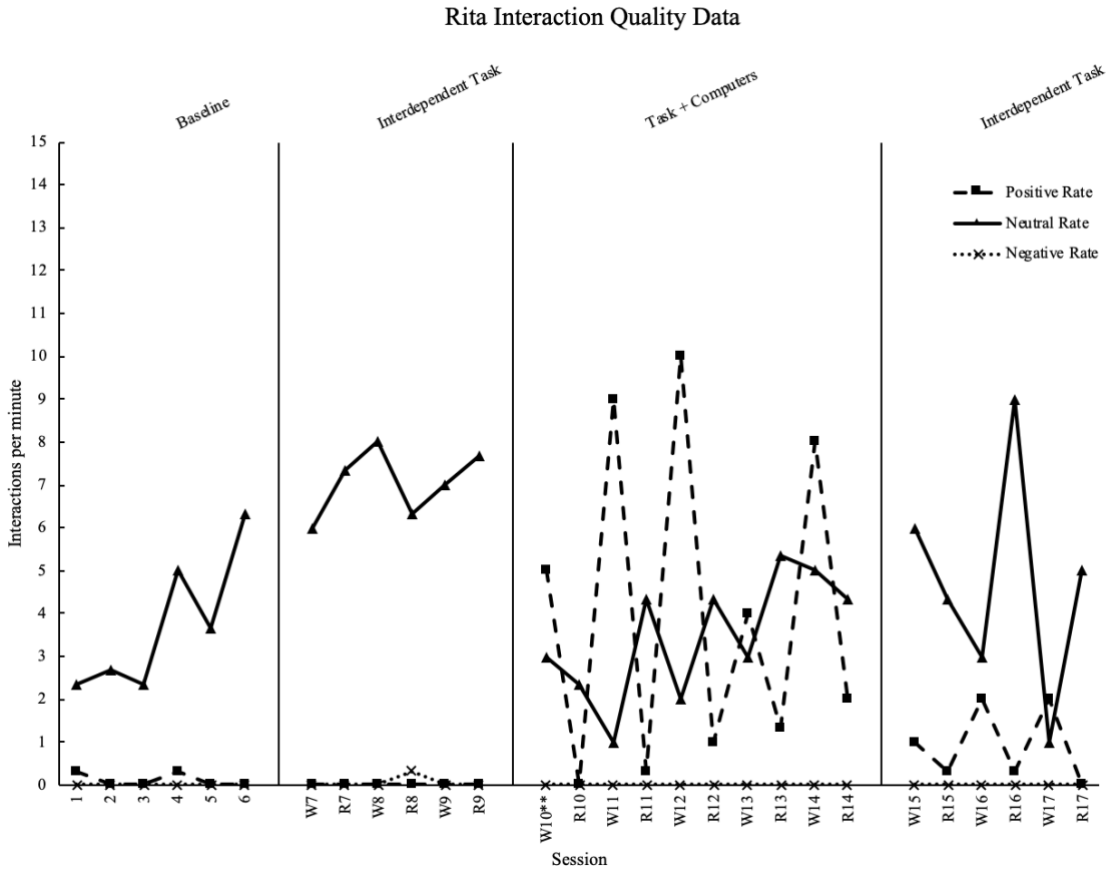

Figure 9: Rita's Social Interaction Quality in Dyad 2 is shown above, with three data paths representing positive, neutral, and negative interactions. Along the y-axis is the rate of interactions per minute. Along the x axis are the baseline reinforcement sessions (BL), the work sessions (W#), and the reinforcement sessions (R#). Sessions marked with (**) were the first sessions of a new day.

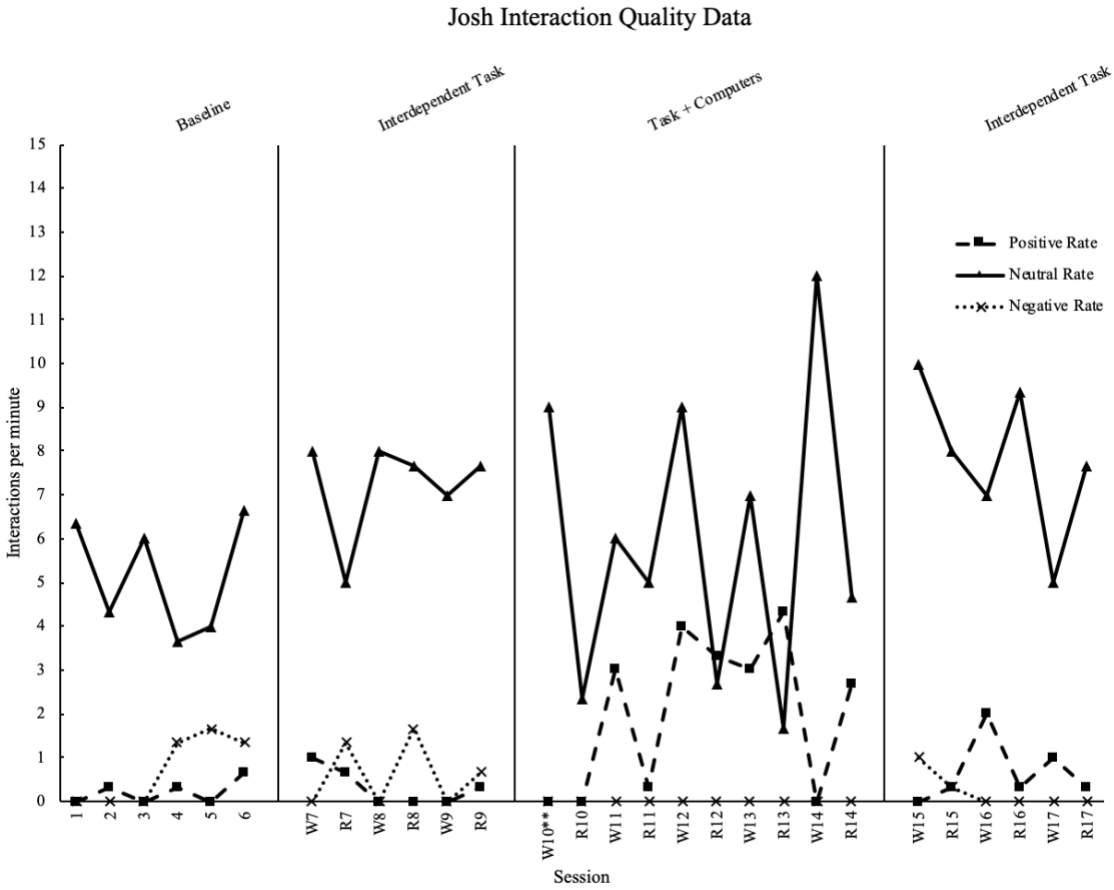

Figure 10: Josh's Social Interaction Quality in Dyad 2 is shown above, with three data paths representing positive, neutral, and negative interactions. Along the y-axis is the rate of interactions per minute. Along the x axis are the baseline reinforcement sessions (BL), the work sessions (W#), and the reinforcement sessions (R#). Sessions marked with (**) were the first sessions of a new day.

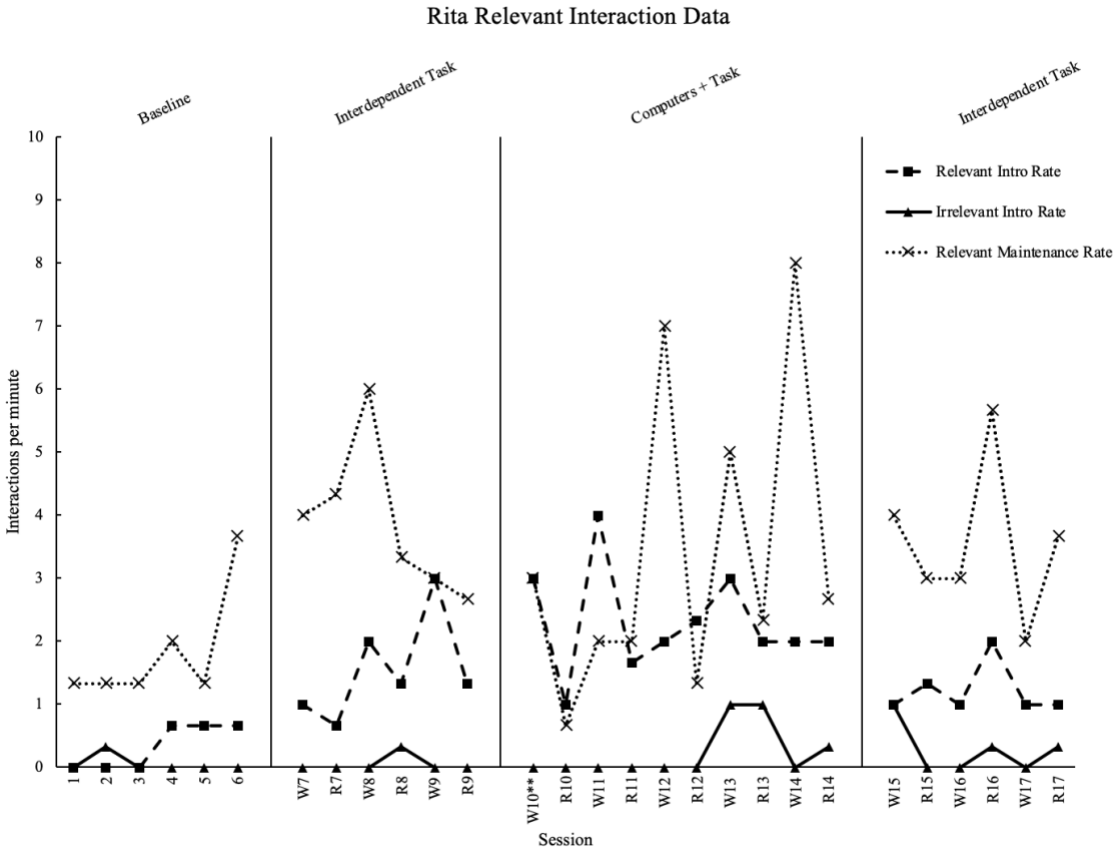

Figure 11: Social Interaction Relevance is shown for Rita. Rate of Interactions is along the y-axis, and sessions are along the x-axis and identified as work (W#) or reinforcement (R#) sessions. Sessions marked with (**) were the first sessions of a new day.

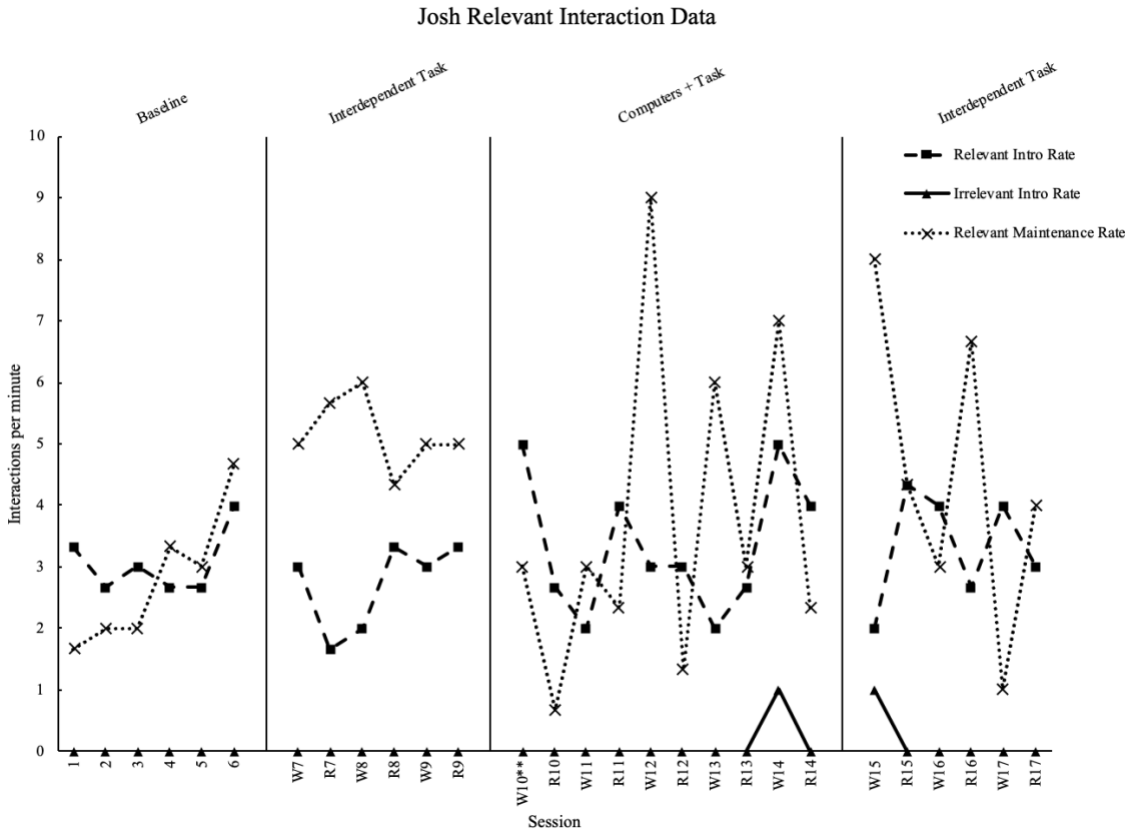

Figure 12: Social Interaction Relevance is shown for Josh. Rate of Interactions is along the y-axis, and sessions are along the x-axis and identified as work (W#) or reinforcement (R#) sessions. Sessions marked with (**) were the first sessions of a new day.